

What is claimed is:

1. A fuel injector comprising:
 - a first accumulator for accumulating a pressurized fuel;
 - a second accumulator for accumulating a fuel having a higher pressure than the pressure of the fuel in the first accumulator;
 - fuel injection valves to which the fuel from the first and second accumulators is supplied and thereby the fuel injection valves are opened, and the fuel is injected;
 - fuel feeding pipes for feeding the fuel accumulated in the first and second accumulators to the fuel injection valves;
 - a first valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the first accumulator to the fuel injection valves;
 - a second valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the second accumulator to the fuel injection valves; and
 - a control device for controlling the first and second valve mechanisms;
wherein the first accumulator and the first valve mechanism, and the second accumulator and the second valve mechanism are provided in parallel to each other to the fuel feeding pipe;
 - wherein in a normal injection mode, the control device makes the first and second valve mechanisms open at the same time; and
wherein in an injection rate control mode, the control device makes an open timing of the first valve mechanism earlier than an open timing in the normal injection mode.

2. A fuel injector comprising:

a first accumulator for accumulating a pressurized fuel;

a second accumulator for accumulating a fuel having a higher pressure than the pressure of the fuel in the first accumulator;

fuel injection valves to which the fuel from the first and second accumulators is supplied and thereby the fuel injection valves are opened, and the fuel is injected;

fuel feeding pipes for feeding the fuel accumulated in the first and second accumulators to the fuel injection valves;

a first valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the first accumulator to the fuel injection valves;

a second valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the second accumulator to the fuel injection valves; and

a control device for controlling the first and second valve mechanisms;

wherein the first valve mechanism is provided at the fuel feeding pipe downstream of the second valve mechanism in a flow direction of the fuel toward the fuel injection valves;

wherein in a normal injection mode, the control device makes the first and second valve mechanisms open at the same time; and

wherein in an injection rate control mode, the control device makes an open timing of the first valve mechanism earlier than an open timing in the normal injection mode.

3. A fuel injector comprising:

a first accumulator for accumulating a pressurized fuel;

a second accumulator for accumulating a fuel having a higher pressure than the pressure of the fuel in the first accumulator;

fuel injection valves to which the fuel from the first and second accumulators is supplied and thereby the fuel injection valves are opened, and the fuel is injected;

fuel feeding pipes for feeding the fuel accumulated in the first and second accumulators to the fuel injection valves;

a first valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the first accumulator to the fuel injection valves;

a second valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the second accumulator to the fuel injection valves; and

a control device for controlling the first and second valve mechanisms;

wherein the first accumulator and the first valve mechanism, and the second accumulator and the second valve mechanism are provided in parallel to each other to the fuel feeding pipe;

wherein in a normal injection mode, the control device makes the first and second valve mechanisms open at the same time; and

wherein in an injection rate control mode, the control device makes an open timing of the second valve mechanism later than an open timing in the normal injection mode.

4. A fuel injector comprising:

a first accumulator for accumulating a pressurized fuel;

a second accumulator for accumulating a fuel having a higher pressure than the pressure of the fuel in the first accumulator;

fuel injection valves to which the fuel from the first and second accumulators is supplied and thereby the fuel injection valves are opened, and the fuel is injected;

fuel feeding pipes for feeding the fuel accumulated in the first and second accumulators to the fuel injection valves;

a first valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the first accumulator to the fuel injection valves;

a second valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the second accumulator to the fuel injection valves; and

a control device for controlling the first and second valve mechanisms;
wherein the first valve mechanism is provided at the fuel feeding pipe downstream of the second valve mechanism in a flow direction of the fuel toward the fuel injection valves;

wherein in a normal injection mode, the control device makes the first and second valve mechanisms open at the same time; and

wherein in an injection rate control mode, the control device makes an open timing of the second valve mechanism later than an open timing in the normal injection mode.

5. A fuel injector according to claim 1, wherein, during the injection rate control mode, the control device makes an open timing of the first valve mechanism earlier than the open timing in the normal injection mode; and the control device makes an open timing of the second valve mechanism later than an open timing in the normal injection mode.

6. A fuel injector according to claim 2, wherein, during the injection rate control mode,

the control device makes an open timing of the first valve mechanism earlier than the open timing in the normal injection mode; and the control device makes an open timing of the second valve mechanism later than an open timing in the normal injection mode.

7. A fuel injector according to claim 1, wherein the control device makes the open timing of the first valve mechanism advance gradually.

8. A fuel injector according to claim 2, wherein the control device makes the open timing of the first valve mechanism advance gradually.

9. A fuel injector according to claim 5, wherein the control device makes the open timing of the first valve mechanism advance gradually.

10. A fuel injector according to claim 6, wherein the control device makes the open timing of the first valve mechanism advance gradually.

11. A fuel injector according to claim 3, wherein the control device makes the open timing of the second valve mechanism retard gradually.

12. A fuel injector according to claim 4, wherein the control device makes the open timing of the second valve mechanism retard gradually.

13. A fuel injector according to claim 5, wherein the control device makes the open timing of the second valve mechanism retard gradually.

14. A fuel injector according to claim 6, wherein the control device makes the open timing of the second valve mechanism retard gradually.

15. A fuel injector according to claim 1, wherein a pump for increasing the pressure of the fuel to a predetermined value is provided for each of the first and second accumulators.

16. A fuel injector according to claim 2, wherein a pump for increasing the pressure of the fuel to a predetermined value is provided for each of the first and second accumulators.

17. A fuel injector according to claim 3, wherein a pump for increasing the pressure of the fuel to a predetermined value is provided for each of the first and second accumulators.

18. A fuel injector according to claim 4, wherein a pump for increasing the pressure of the fuel to a predetermined value is provided for each of the first and second accumulators.

19. A fuel injector comprising:

- a first accumulator for accumulating a pressurized fuel;
- a second accumulator for accumulating a fuel having substantially the same pressure as the pressure of the fuel in the first accumulator;
- fuel injection valves to which the fuel from the first and second accumulators is supplied and thereby the fuel injection valves are opened, and the fuel is injected;

fuel feeding pipes for feeding the fuel accumulated in the first and second accumulators to the fuel injection valves;

a first valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the first accumulator to the fuel injection valves;

a fuel pressure reducing device for reducing the pressure of fuel which passes through the first accumulator and is supplied to the fuel injection valves;

a second valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the second accumulator to the fuel injection valves; and

a control device for controlling the first and second valve mechanisms and the fuel pressure reducing device;

wherein, in a normal injection mode, the control device makes the first valve mechanism open earlier than the second valve mechanism; and

wherein in an injection rate control mode, the control device operates the fuel pressure reducing device, and thereby the pressure of the fuel passing through the first accumulator and supplied to the fuel injection valves is reduced.

20. A fuel injector comprising:

a first accumulator for accumulating a pressurized fuel;

a second accumulator for accumulating a fuel having substantially the same pressure as the pressure of the fuel in the first accumulator;

fuel injection valves to which the fuel from the first and second accumulators is supplied and thereby the fuel injection valves are opened, and the fuel is injected;

fuel feeding pipes for feeding the fuel accumulated in the first and second accumulators to the fuel injection valves;

a first valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the first accumulator to the fuel injection valves;

a fuel pressure reducing device for reducing the pressure of fuel which passes through the first accumulator and is supplied to the fuel injection valves;

a second valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the second accumulator to the fuel injection valves; and

a control device for controlling the first and second valve mechanisms and the fuel pressure reducing device;

wherein, in a normal injection mode, the control device makes the first and second valve mechanisms open at the same time; and

wherein in an injection rate control mode, the control device makes the open timing of the second valve mechanism later than the open timing in the normal injection mode, while the control device operates the fuel pressure reducing device, and thereby the pressure of the fuel passing through the first accumulator and supplied to the fuel injection valves is reduced.

21. A fuel injector according to claim 19, wherein the first valve mechanism is provided at the fuel feeding pipe downstream of the second valve mechanism in a flow direction of the fuel toward the fuel injection valves.

22. A fuel injector according to claim 20, wherein the first valve mechanism is provided at the fuel feeding pipe downstream of the second valve mechanism in a flow direction of the fuel toward the fuel injection valves.

23. A fuel injector according to claim 19, wherein the control device makes the open timings of the first and second valve mechanisms in the injection rate control mode earlier than those of the first and second valve mechanisms in the normal injection mode.
24. A fuel injector according to claim 20, wherein the control device makes the open timings of the first and second valve mechanisms in the injection rate control mode earlier than those of the first and second valve mechanisms in the normal injection mode.
25. A fuel injector according to claim 20, wherein the control device makes the open timing of the first valve mechanism in the injection rate control mode earlier than that of the first valve mechanism in the normal injection mode.
26. A fuel injector according to claim 22, wherein the control device makes the open timing of the first valve mechanism in the injection rate control mode earlier than that of the first valve mechanism in the normal injection mode.
27. A fuel injector according to claim 19, wherein the control device operates the fuel pressure reducing device, and thereby the pressure of the fuel is reduced gradually.
28. A fuel injector according to claim 20, wherein the control device operates the fuel pressure reducing device, and thereby the pressure of the fuel is reduced gradually.
29. A fuel injector according to claim 19, wherein a pump for increasing the pressure of the fuel to a predetermined value is provided for each of the first and second accumulators.

30. A fuel injector according to claim 20, wherein a pump for increasing the pressure of fuel to a predetermined value is provided for each of the first and second accumulators.

31. A fuel injector comprising:

at least one accumulator for accumulating a pressurized fuel;
fuel injection valves to which the fuel from the accumulator is supplied and thereby the fuel injection valves are opened, and the fuel is injected;
fuel feeding pipes for feeding the fuel accumulated in the accumulator to the fuel injection valves; and
at least one valve which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the accumulator to the fuel injection valves;
wherein a least one flow fuse comprising an excess flow check mechanism is provided between the accumulator and the valve.

32. A fuel injector according to claim 31, wherein the accumulator comprises a first accumulator for accumulating a pressurized fuel and a second accumulator for accumulating a fuel having a higher pressure than the pressure of the fuel in the first accumulator;

wherein the valve mechanism comprises a first valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the first accumulator to the fuel injection valves and a second valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the second accumulator to the fuel injection valves; and

wherein the flow fuse is provided between the first accumulator and the first

valve mechanism, and between the second accumulator and the second valve mechanism.

33. A fuel injector according to claim 31, wherein the accumulator, the valve mechanism, and the flow fuse comprise a unit.

34. A fuel injector according to claim 33, wherein the valve mechanism comprises one unit, and the unit comprising the valve mechanism is detachable from the unit comprising the accumulator and the flow fuse.

35. A fuel injector comprising:

at least one accumulator for accumulating a pressurized fuel;

fuel injection valves to which the fuel is supplied from the accumulator and thereby the fuel injection valves are opened, and the fuel is injected;

fuel feeding pipes for feeding the fuel accumulated in the accumulator to the fuel injection valves; and

at least one valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the accumulator to the fuel injection valves;

wherein the accumulator comprises at least two accumulators which accumulate fuel at different pressures;

wherein the valve mechanism is provided for each of the accumulators; and

wherein the valve mechanisms provided for the accumulators accumulating fuel at different pressures are opened, in order of the lowness of the pressure of the fuel accumulated in the accumulators.

36. A fuel injector according to claim 35, wherein the valve mechanism for the

accumulator accumulating fuel having the lowest pressure is provided at the fuel feeding pipe downstream of the other valve mechanisms in a flow direction of the fuel toward the fuel injection valves.

37. A fuel injector according to claim 35, wherein the accumulator comprises a first accumulator for accumulating a pressurized fuel and a second accumulator for accumulating a fuel having a higher pressure than the pressure of the fuel in the first accumulator; and

wherein the valve mechanism comprises a first valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the first accumulator to the fuel injection valves and a second valve mechanism which is provided at the fuel feeding pipe and which opens and allows the flow of the fuel in the second accumulator to the fuel injection valves.

38. A fuel injector according to claim 37, wherein the first valve mechanism is provided at the fuel feeding pipe downstream of the second valve mechanism in a flow direction of the fuel toward the fuel injection valves.

39. A fuel injector according to claim 35, wherein a pump for increasing the pressure of fuel to a predetermined value is provided for the accumulator.

40. A diesel engine comprising the fuel injector according to claim 1 and cylinder heads provided with the fuel injection valves.

41. A diesel engine according to claim 40, wherein the accumulators and the valve

mechanisms are provided separately from the cylinder heads.

42. A diesel engine according to claim 41, wherein the diesel engine comprises a governor for detecting a load of the diesel engine, and the control device controls the valve mechanisms based on signals from the governor.

43. A diesel engine comprising the fuel injector according to claim 2 and cylinder heads provided with the fuel injection valves.

44. A diesel engine according to claim 43, wherein the accumulators and the valve mechanisms are provided separately from the cylinder heads.

45. A diesel engine according to claim 44, wherein the diesel engine comprises a governor for detecting a load of the diesel engine, and the control device controls the valve mechanisms based on signals from the governor.

46. A diesel engine comprising the fuel injector according to claim 3 and cylinder heads provided with the fuel injection valves.

47. A diesel engine according to claim 46, wherein the accumulators and the valve mechanisms are provided separately from the cylinder heads.

48. A diesel engine according to claim 47, wherein the diesel engine further comprises a governor for detecting a load of the diesel engine, and the control device controls the valve mechanisms based on signals from the governor.

49. A diesel engine comprising the fuel injector according to claim 4 and cylinder heads provided with the fuel injection valves.
50. A diesel engine according to claim 49, wherein the accumulators and the valve mechanisms are provided separately from the cylinder heads.
51. A diesel engine according to claim 50, wherein the diesel engine further comprises a governor for detecting a load of the diesel engine, and the control device controls the valve mechanisms based on signals from the governor.
52. A diesel engine comprising the fuel injector according to claim 19 and cylinder heads provided with the fuel injection valves.
53. A diesel engine according to claim 52, wherein the accumulators and the valve mechanisms are provided separately from the cylinder heads.
54. A diesel engine according to claim 53, wherein the diesel engine further comprises a governor for detecting a load of the diesel engine, and the control device controls the valve mechanisms and the fuel pressure reducing device based on signals from the governor.
55. A diesel engine comprising the fuel injector according to claim 20 and cylinder heads provided with the fuel injection valves.

56. A diesel engine according to claim 55, wherein the accumulators and the valve mechanisms are provided separately from the cylinder heads.

57. A diesel engine according to claim 56, wherein the diesel engine further comprises a governor for detecting a load of the diesel engine, and the control device controls the valve mechanisms and the fuel pressure reducing device based on signals from the governor.

58. A diesel engine comprising the fuel injector according to claim 31 and cylinder heads provided with the fuel injection valves.

59. A diesel engine according to claim 58, wherein the accumulator, the valve mechanism, and the flow fuse are provided separately from the cylinder heads.

60. A diesel engine comprising the fuel injector according to claim 35 and cylinder heads provided with the fuel injection valves.

61. A diesel engine according to claim 60, wherein the accumulator and the valve mechanism are provided separately from the cylinder heads.

62. A fuel injector according to claim 61, wherein the accumulator and the valve mechanism comprise a unit.

63. A fuel injector according to claim 62, wherein a flow fuse is provided between the accumulator and the valve mechanism, and the valve mechanism is detachable from the

accumulator and the flow fuse.